



Social relationships play a role in sleep status in Chinese undergraduate students



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ABSTRACT

The purpose of this study was to examine whether social relationships were associated with sleep status in Chinese undergraduate students. A cross-sectional questionnaire survey was conducted in November 2012 at Huzhou Teachers College, China. The questionnaire involved demographic characteristics, personal lifestyle habits, social relationships and Pittsburgh Sleep Quality Index (PSQI). The associations between social relationships and sleep status were analyzed by using regression models after adjustment for potential factors. Poor sleep quality was prevalent among Chinese undergraduate students. Men tended to have better sleep than women. Lower social stress, better management of stress and good social support were correlated with better sleep status, and stress or support from friends, family and classmates were all related with sleep variables. While only weak associations between number of friends and sleep were detected. The results were consistent in men and women. Educators and instructors should be aware of the importance of social relationships as well as healthy sleep in undergraduates.

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1. Introduction

Complaints about sleep are worldwide in contemporary population, ranging from adolescents to elders, in both men and women. Good sleep is the basics of high quality of life while poor sleep can influence physical and mental health (Leger et al., 2006; Bixler, 2009; Cappuccio et al., 2010). It was reported undergraduate students suffered from sleep problems around the globe (Jensen, 2003; Lund et al., 2010), as well as in China (Suen et al., 2008). Poor sleep may be associated with their physical health, psychological health and academic performance (Medeiros et al., 2001; Oginska and Pokorski, 2006; Wong et al., 2013). Undergraduate students meet with many changes and challenges, such as social relationships. Social relationships, including social support, social integration, and negative interaction, were demonstrated to be associated with health outcomes

(Cohen, 2004), as well as sleep status (Yao et al., 2008; Troxel et al., 2010; Chiu et al., 2012). Besides, sleep is not only a health outcome, but also a health related behavior, and it has been proposed to be a mechanism through which social relationships affect health (Hale, 2010). It is necessary to investigate the relationship between social bonds and sleep status, and develop appropriate intervention methods to help undergraduates cope with sleep problems.

In recent years, colleges and universities in China have expanded their enrollments dramatically, while educational resource was not increased correspondingly (Wan, 2006). There are 2409 regular Higher Education Institutions (HEIs) in 2011 in China. Out of 2409 HEIs, 1602 (66.5%) were affiliated with local governments which have middle education level and similar environment (Ministry of Education, 2012). And Huzhou Teachers College belongs to such HEI. A majority of high school students have been enrolled in these HEIs every year, so these students accounted for a main proportion of Chinese undergraduates. It was reported undergraduate students in China faced great sleep problems (Suen et al., 2008; Cheng et al., 2012). However, there were only few studies focused on the role of social relationships on sleep status in university students (Cheng et al., 2012; Galambos et al., 2013), and the number of studies in

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Chinese students were even less (Cheng et al., 2012). Our study was aimed to examine whether social stress, support or integration were associated with sleep status in these undergraduate students in Huzhou Teachers College. Moreover, relationships from family, friends and classmates were analyzed separately to determine which factors might play more important role in sleep status. Besides, medical students had great pressure due to academic demands, and tended to have poor sleep status, with insufficient sleep duration and delayed sleep onset (Abdulghani et al., 2012). So we mainly focused on medical students.

2. Methods

2.1. Subjects and procedures

Huzhou Teachers College (Zhejiang, China) is a comprehensive full-time college containing 11 major disciplines. All students majored in medicine and life sciences in first, second and third year were invited to participate in this study during 26th to 30th November 2012. Students in fourth year (senior students) were in the internship outside the school so they were not investigated. Questionnaires were distributed by monitors in each class in their specialized classrooms during the night self-studies. Students were asked to complete the questionnaires in 20 min without monitoring, independently and voluntarily. Informed consent was obtained from each participant. The Ethical Committee at Zhejiang University approved the study protocol.

2.2. Study survey

2.2.1. Demographic characteristics and personal lifestyle habits

The first part of our well constructed questionnaire included sex, age, ethnic, grade/study year, major, resident location, parent relationship, family economic status, and height and weight. The body mass index (BMI) was defined as the weight in kilograms divided by the square of the height in meters. We set the cutoffs of BMI according to the criterion made by Working Group on Obesity in China (WGOC), which is more suitable for Chinese population, that is, ≥ 24.0 as overweight, ≥ 28.0 as obesity, and < 18.5 as underweight. The personal lifestyle habits, like cigarette smoking, alcohol drinking, physical exercise, social activity, internet use and courtship, were also involved. No smoking means never smoking, and no alcohol drinking means never drinking. Physical exercise and internet use were defined by frequency. Whether attending social activity frequently were estimated by students themselves.

2.2.2. Assessment of social relationships

We assessed three aspects of social relationships: social support, social integration, and social stress. Standard questionnaire made by Stinson et al. (2008) was used. But in order to make the questionnaire more appropriate to undergraduate students, the following contents were modified: in items of social relationship, “partner” was replaced to “classmates”; in items of social stress, “partner” and “neighbors” were discarded, which was not suitable to undergraduates. And 6-point scale was decreased to 4-point scale in items of ability to handle stress to make items concise. Finally, social stress that participant suffered from family, friends, and classmates was assessed using a 4-point scale (from 0, no stress, to 3, severe stress), and corresponding questions were set to assess the ability to handle these stress (from 0, cannot handle, to 3, handle well). Social support was evaluated by measuring comfort, relational doubts, and relationship satisfaction with family, friends, and classmates in nine items (first three: “I am comfortable being close to my family/friends/classmates”; second three: “I wonder whether my family/friends/classmates really care about me” (reverse scored); third three: “In general, I am satisfied with my family relationships/friendships/classmate relationships”). Each item was scored from 1, strongly disagree, to 7, strongly agree. Social integration was measured by reporting total number of friends live locally and live at a distance. “Friends” means anyone who you choose to classify in this way. “Locally” means living in the same city. If a friend does not live locally, he/she is classified as living “at a distance”. Total scores of social stress, management of stress and social support were achieved by adding scores of each item. Categories of social stress, management of stress and social support were created according to the lower quartile (Q1) and upper quartile (Q3) of the score. The reliability and validity of the questionnaire were also analyzed. The Cronbach α was 0.83 of our social relationship questionnaires. Factor analysis showed good construct validity, with five factors explaining 66% variation and all items having high factor loadings (> 0.6).

2.2.3. Measurement of sleep status

Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989) is a self-rated questionnaire used to assess sleep quality and disturbances during the last month.

It includes 19 self-rated questions and five other-rated questions, containing seven parts: sleep duration, subjective sleep quality, habitual sleep efficiency, use of sleeping medication, daytime dysfunction, sleep latency, and sleep disturbances. Total score is 0 to 21 points, with 0 to 3 points in each part, and lower scores indicate better sleep status. In this research, Chinese version of the Pittsburgh Sleep Quality Index (PSQI) (Liu et al., 1996) was used to assess participants' sleep status. It has been documented that the Chinese version of the PSQI has good reliability, validity, and internal consistency in Chinese people (Liu et al., 1996; Tsai et al., 2005). We assessed five parts of PSQI, which were subjective sleep quality, sleep duration, habitual sleep efficiency, use of sleeping medication, and daytime dysfunction, to evaluate the sleep status in undergraduate students. The variables of subjective sleep quality, sleep duration, sleep efficiency and sleep latency in the analyses are self-reported items in the PSQI scale.

2.3. Statistical analysis

Subjects who completed the items of social relationships and PSQI were included in the analyses. Descriptive statistics were used to characterize all study samples, as well as men and women separately. Difference analyses between included subjects and excluded subjects in this manuscript were performed to test selection bias. Spearman correlation among social support, social stress and social integration was detected. Stepwise regression was used to screen significant covariates for fixed models in whole samples, men and women, respectively. Covariates included sex, study grade, major, resident location, parent relationship, and personal lifestyle habits like cigarette smoking, alcohol drinking, physical exercise, social activity and courtship. Multivariate linear regression models were used to detect the association between PSQI, sleep duration, sleep efficiency and social relationships. Multinomial logistic regression models were utilized to detect the association between subjective sleep quality and social relationships, and binary logistic regression models for the association between sleep duration and social relationships. We also analyzed the relationship of stress and support from family, friends and classmates with sleep status, separately. All statistical analyses were performed by using SAS software (Version 9.2. Institute, Inc., Cary, NC, USA) and P less than 0.05 was considered as statistical significant level.

3. Results

Finally, 2987 questionnaires were distributed and 2296 questionnaires were retrieved (response rate = $2296/2987 = 76.9\%$). After excluding 19 blank questionnaires, 2277 questionnaires were valid (efficient rate = $2277/2296 = 99.2\%$), but 645 questionnaires were excluded in present study due to lack of essential information (183 for PSQI score and 556 for social relationships). Hence 1632 subjects were involved in the analyses. Of these, 343 (21.0%) were men and 1289 (79.0%) were women. The average age was $19.73 (\pm 1.03)$ years, with a range of 16 to 23. The number of students who reported fairly bad or very bad sleep was 371 (22.7%). Differences between men and women were found in demographic characteristics and personal lifestyle habits. Men had better subjective sleep quality ($\chi^2 = 7.54$, d.f. = 3, $P = 0.0060$), longer sleep time ($t = 3.13$, d.f. = 1630, $P = 0.0018$) and shorter sleep latency ($\chi^2 = 15.05$, d.f. = 1, $P = 0.0001$) than women, while the PSQI score ($t = -1.20$, d.f. = 1, $P = 0.23$) and sleep efficiency ($t = -0.91$, d.f. = 1630, $P = 0.36$) did not reach statistical significance (Table 1). Men had lower social stress ($t = -2.68$, d.f. = 1630, $P = 0.0075$) and more friends (locally: $t = 43.01$, d.f. = 1630, $P < 0.0001$; at a distance: $t = 32.40$, d.f. = 1630, $P < 0.0001$) than women (Table 1). Significant correlations were found between social support and social stress ($r = 0.4131$, $P < 0.0001$) or stress management ($r = 0.5074$, $P < 0.0001$). While the correlations among number of friends and social support or social stress or stress management were pretty modest ($r = 0.1940$, -0.1379 , 0.2197 , respectively, all $P < 0.0001$) (Supplemental Table 1).

3.1. Social stress and sleep

Social stress was positively related with PSQI scores (mild stress: $\beta = 0.74$, $P < 0.0001$; moderate or severe stress: $\beta = 1.33$, $P < 0.0001$) and poor subjective sleep quality (mild stress: OR = 3.01, 95%CI, 2.07–4.38; moderate or severe stress: OR = 5.01,

Table 1Background characteristics for the enrolled subjects ($n=1632$).

Variables	Total	Men ($n=343$)	Women ($n=1289$)	Test statistic	d.f.	P value ^a
Age, year(Mean \pm S.D.)	19.73 \pm 1.03	19.74 \pm 1.03	19.72 \pm 1.04	0.21	1630	0.84*
BMI (kg/m²), N (%)				54.28	3	< 0.00011;#
18.5–23.9	989(60.6)	225(65.6)	764(59.3)			
< 18.5	384(23.5)	41(12.0)	343(26.6)			
24–27.9	61(3.7)	29(8.5)	32(2.5)			
≥ 28	23(1.4)	10(2.9)	13(1.0)			
Missing	175(10.7)	38(11.1)	137(10.6)			
Grade/study year, N (%)				9.32	2	0.00231;#
1st	457(28.0)	118(34.4)	339(26.3)			
2nd	678(41.5)	136(39.7)	541(42.0)			
3rd	497(30.5)	88(25.7)	409(31.7)			
Major, N (%)				160.62	3	< 0.00011;#
Clinical medicine	405(24.8)	140(40.8)	265(20.6)			
Nursing	542(33.2)	20(5.8)	522(40.5)			
Other medicine ^b	142(8.7)	47.0(13.7)	95(7.4)			
Non-medicine	543(33.3)	136(39.7)	407(31.6)			
Resident location, N (%)				6.77	1	0.00931;#
Urban	345(21.1)	90(26.2)	255(19.8)			
Rural	1287(78.9)	253(73.8)	1034(80.2)			
Parent relationships, N (%)				0.65	2	0.421;#
Good	1165(71.4)	253(73.8)	912(70.8)			
Moderate	410(25.1)	77(22.5)	333(25.8)			
Poor	57(3.5)	13(3.8)	44(3.4)			
Family economic status, N (%)				0.72	2	0.401;#
Good	450(27.6)	84(24.5)	366(28.4)			
Moderate	789(48.4)	176(51.3)	613(47.6)			
Poor	286(17.5)	71(20.7)	215(16.7)			
Missing	107(6.6)	12(3.5)	95(7.4)			
Cigarette smoker, N (%) ^c				228.48	1	< 0.00011;#
No	1553(95.2)	273(79.6)	1280(99.3)			
Yes	79(4.8)	70(20.4)	9(0.7)			
Alcohol, N (%) ^d				96.81	1	< 0.00011;#
No	1123(68.8)	161(46.9)	962(74.6)			
Yes	509(31.2)	182(53.1)	327(25.4)			
Physical exercise, N (%)				45.02	1	< 0.00011;#
< 3 times/week	1157(70.9)	193(56.3)	964(74.8)			
≥ 3 times/week	475(29.1)	150(43.7)	325(25.2)			
Classmate party, N (%)				10.55	1	0.00121;#
Not frequently	944(57.8)	172(50.2)	772(59.9)			
Frequently	688(42.2)	171(49.9)	517(40.1)			
Frequency of network, N (%)				0.02	2	0.881;#
0 times/week	35(2.1)	14(4.1)	21(1.6)			
1–3 times/week	471(28.9)	87(25.4)	384(29.8)			
≥ 4 times/week	1126(69.0)	242(70.6)	884(68.6)			
Courtship, N (%)				1.23	1	0.271;#
No	1153(70.7)	234(68.2)	919(71.3)			
Yes	479(29.4)	109(31.8)	370(28.7)			
PSQI (Mean \pm S.D.)	2.99 \pm 1.90	2.87 \pm 2.13	3.02 \pm 1.84	– 1.20	1	0.23*
Actual sleep time (Mean \pm S.D.)	7.29 \pm 1.03	7.45 \pm 1.03	7.25 \pm 1.03	3.13	1630	0.0018*
Sleep/bed time (Mean \pm S.D.)	0.90 \pm 0.14	0.89 \pm 0.16	0.90 \pm 0.14	– 0.91	1630	0.36*
Subjective sleep quality, N (%)				7.54	3	0.00601;#
Very good	405(24.8)	114(33.2)	291(22.6)			
Fairly good	856(52.5)	155(45.2)	701(54.4)			
Fairly bad	336(20.6)	67(19.5)	269(20.9)			
Very bad	35(2.1)	7(2.0)	28(2.2)			
Sleep latency, N (%)				15.05	1	0.00011;#
< 30 min	1079(66.1)	257(74.9)	822(63.8)			
≥ 30 min	553(33.9)	86(25.1)	467(36.2)			
Score of social stress (Mean \pm S.D.)	1.6 \pm 1.4	1.4 \pm 1.5	1.6 \pm 1.4	– 2.68	1630	0.0075*
Score of ability of handle social stress (Mean \pm S.D.)	6.0 \pm 2.3	6.2 \pm 2.5	5.9 \pm 2.2	1.87	1630	0.063*
Score of social support (Mean \pm S.D.)	48.1 \pm 10.2	47.3 \pm 10.7	48.3 \pm 10.1	– 1.72	1630	0.085*
Number of friends locally, Median (P25, P75)	10(7,20)	18(10,40)	10(6,20)	43.01	1630	< 0.00012;§
Number of friends at a distance, Median (P25, P75)	8(4,15)	10(5,25)	7(4,11)	32.40	1630	< 0.00012;§

* t -test was used among continuous variables.

Chi-square test was used among categorical variables.

§ Wilcoxon rank sum test was used.

^a Differences between men and women.^b Include medical technology, oral medicine and health service management.^c “No” means smoking less than 10 packages per year.^d “No” means drinking less than 12 times per year.

95%CI, 3.21–7.69). Similar associations were also detected in men and women, respectively. Social stress also had a relationship with actual sleep time in whole samples (mild stress: $\beta = -0.17$, $P = 0.0070$; moderate or severe stress: $\beta = -0.23$, $P = 0.0012$), and similar associations were found in men but not in women. Moderate or severe stress was related with lower sleep efficiency ($\beta = -0.03$, $P = 0.0004$). Besides, social stress was associated with longer sleep latency in whole students (OR = 1.73, 95%CI, 1.32–2.26; OR = 2.33, 95%CI, 1.72–3.16), and similar relationships were found in women; while in men it only showed a tendency, with no statistical significance (Table 2). Different types of stress all made contributions (Supplemental Table 2). Students who had lower ability of coping with social stress reported worse sleep status (Table 3).

3.2. Social support and sleep

Students with good social support reported lower PSQI scores ($\beta = -0.59$, $P < 0.0001$), and those with poor social support reported higher PSQI scores ($\beta = 0.30$, $P = 0.0085$). Similar results were observed in women. In men, lower PSQI scores were also showed in those with good social support than those with normal social support, while no significant result was detected in those with poor social support compared to normal ones. Students with good social support also tended to have longer sleep time ($\beta = 0.16$, $P = 0.0094$), higher sleep efficiency ($\beta = 0.02$, $P = 0.029$), good subjective sleep quality (OR = 0.48, 95%CI, 0.33–0.70), and shorter sleep latency (OR = 0.67, 95%CI, 0.52–0.88), and results were similar in women but not significant in men (Table 4). Besides, support from friends, family and classmates were also associated with sleep status (Supplemental Table 3).

3.3. Social integration and sleep

Students with more local friends had lower PSQI scores ($\beta = -0.32$, $P = 0.016$). Similar results were observed in women. Women who had more local friends also have higher sleep efficiency. The number of friends living at a distance was not associated with sleep status. (Table 5)

4. Discussion

The present study investigated sleep status in Chinese undergraduate students and found about one in five students reported poor subjective sleep quality, and women seemed to have worse condition. We also examined the association of social relationships with sleep status in Chinese undergraduate students. Our results revealed that, in both men and women, heavier social stress was related with worse sleep status, and good social support was associated with better sleep status. Family relationships, friendships and classmate relationships were all related with sleep status.

Other studies (Feng et al., 2005; Kang and Chen, 2009) had reported 33.8% and 19% of medical students suffering from poor sleep quality in China, which were consistent with that (22.7%) in our study, implying that sleep problem is serious in undergraduates. Our study revealed less perceived stress and good perceived support was associated with better sleep, and this was also consistent with other previous studies (Cheng et al., 2012; Galambos et al., 2013). Literatures have demonstrated psychosocial stress can impair sleep (Utsugi et al., 2005; Akerstedt et al., 2007). What's more, a vicious circle seems to exist between sleep impairment and stress, that is, poor sleep caused by stress may further stimulate hypothalamic-pituitary-adrenal (HPA) system and deteriorate stress status (Akerstedt, 2006). Stress can influence health and impair sleep through physiological systems activation and behavior moderation (Cohen, 2004; Phillips and Mannino, 2005; Akerstedt, 2006). Social support is a well documented psychosocial factor which can influence health outcomes (Uchino, 2004). Social support can be measured in terms of structural support or functional support (Stinson et al., 2008). Structural support, also regarded as social integration, refers to one's depth of integration into his or her social network, such as number of friends and relatives; and functional support means emotional, instrumental, and informational support these people can provide. Both types of support were proven to have health benefits (Stinson et al., 2008). Social support has been deemed to be stress buffering (Cohen, 2004), and a negative correlation between social support and social stress, and a positive correlation between social support and stress management also support this

Table 2
Relationships between social stress and sleep variables.

	Total (n = 1632) ^a			Men (n = 343) ^b			Women (n = 1289) ^c		
	No stress	Mild stress	Moderate or severe	No stress	Mild stress	Moderate or severe	No stress	Mild stress	Moderate or severe
Sleep conditions^d									
PSQI	REF	0.74 (0.11)	1.33 (0.13)**	REF	0.93 (0.24)**	1.49 (0.28)**	REF	0.64 (0.12)**	1.24 (0.14)**
Sleep duration^d									
Actual sleep time	REF	-0.17 (0.06)**	-0.23 (0.07)**	REF	-0.35 (0.13)**	-0.35 (0.15)*	REF	-0.10 (0.07)	-0.18 (0.08)*
Sleep efficiency^d									
Sleep/bed time	REF	-0.01 (0.01)	-0.03 (0.01)**	REF	-0.03 (0.02)	-0.06 (0.02)**	REF	0.00 (0.01)	-0.02 (0.01)*
Subjective sleep quality^e									
Very good	REF			REF			REF		
Fairly good	1.00	2.27 (1.72,3.00)**	2.36 (1.66,3.35)**	1.00	3.44 (1.91,6.20)**	3.01 (1.49,6.06)**	1.00	2.03 (1.47,2.80)**	2.25 (1.49,3.39)**
Fairly/very bad	1.00	3.01 (2.07,4.38)**	5.01 (3.21,7.69)**	1.00	2.62 (1.25,5.48)*	3.06 (1.33,7.06)**	1.00	3.20 (2.05,4.99)**	5.89 (3.54,9.81)**
Sleep latency^f									
< 30 min	REF			REF			REF		
≥ 30 min	1.00	1.73 (1.32,2.26)**	2.33 (1.72,3.16)**	1.00	1.60 (0.88,2.92)	1.91 (0.97,3.74)	1.00	1.77 (1.30,2.40)**	2.45 (1.73,3.47)**

** $P < 0.01$.

* $P < 0.05$.

^a (Model adjusted for sex, study grade, major, resident location, parent relationship, smoke, alcohol, physical exercise, classmate party and courtship.)

^b Model adjusted for study grade, resident location, parent relationship, smoke, alcohol, physical exercise and classmate party.

^c Model adjusted for BMI, study grade, major, resident location, parent relationship, smoke, alcohol, physical exercise, classmate party and courtship.

^d Multivariate linear regression was used. Values are β coefficients (standard errors).

^e Multinomial logistic regression was used. Values are odds ratios (95%confidence intervals).

^f Binary logistic regression was used. Values are odds ratios (95%confidence intervals).

Table 3
Relationships between management ability of social stress and sleep variables

	Total (n=1632) ^a			Men (n=343) ^b			Women (n=1289) ^c		
	Well	Normal	Poor	Well	Normal	Poor	Well	Normal	Poor
Sleep conditions ^d									
PSQI	REF	0.77 (0.11)**	0.80 (0.14)**	REF	0.61 (0.24)*	0.78 (0.31)*	REF	0.82 (0.12)**	0.84 (0.15)**
Sleep duration ^d									
Actual sleep time	REF	−0.18 (0.06)**	−0.04 (0.08)	REF	−0.35 (0.12)**	−0.26 (0.16)	REF	−0.13 (0.07)	0.02 (0.09)
Sleep efficiency ^e									
Sleep/bed time	REF	−0.02 (0.01)*	−0.02 (0.01)	REF	−0.05 (0.02)**	−0.06 (0.02)**	REF	−0.01 (0.01)	−0.01 (0.01)
Subjective sleep quality ^e									
Very good	REF			REF			REF		
Fairly good	1.00	1.37 (0.96,1.96)	1.67 (1.27,2.19)**	1.00	1.06 (0.52,2.16)	1.18 (0.68,2.07)	1.00	1.59 (1.04,2.42)*	1.92 (1.40,2.63)**
Fairly/very bad	1.00	2.34 (1.50,3.66)**	2.91 (2.03,4.15)**	1.00	1.23 (0.51,2.95)	1.43 (0.71,2.87)	1.00	3.09 (1.82,5.27)**	3.88 (2.54,5.94)**
Sleep latency ^e									
< 30 min	REF			REF			REF		
≥ 30 min	1.00	1.70 (1.23,2.34)**	1.48 (1.15,1.91)**	1.00	2.14 (1.05,4.36)*	1.85 (1.02,3.35)*	1.00	1.60 (1.11,2.29)*	1.39 (1.05,1.85)*

** $P < 0.01$.

* $P < 0.05$.

^a Model adjusted for sex, study grade, major, resident location, parent relationship, smoke, alcohol, physical exercise, classmate party and courtship.

^b Model adjusted for study grade, resident location, parent relationship, smoke, physical exercise and classmate party.

^c Model adjusted for BMI, study grade, major, resident location, parent relationship, alcohol, physical exercise, classmate party and courtship.

^d Multivariate linear regression was used. Values are β coefficients (standard errors).

^e Multinomial logistic regression was used. Values are odds ratios (95%confidence intervals).

^f Binary logistic regression was used. Values are odds ratios (95%confidence intervals).

Table 4
Relationships between social support and sleep variables.

	Total (n=1632) ^a			Men (n=343) ^b			Women (n=1289) ^c		
	Normal	Poor	Good	Normal	Poor	Good	Normal	Poor	Good
Sleep conditions ^d									
PSQI	REF	0.30 (0.11)**	−0.59 (0.11)**	REF	−0.08 (0.26)	−0.59 (0.28)*	REF	0.43 (0.13)**	−0.58 (0.12)**
Sleep duration ^d									
Actual sleep time	REF	−0.01 (0.06)	0.16 (0.06)**	REF	0.24 (0.13)	0.22 (0.14)	REF	−0.09 (0.07)	0.14 (0.07)*
Sleep efficiency ^d									
Sleep/bed time	REF	−0.01 (0.01)	0.02 (0.01)*	REF	0.02 (0.02)	0.04 (0.02)	REF	−0.01 (0.01)	0.01 (0.01)
Subjective sleep quality ^e									
Very good	REF			REF			REF		
Fairly good	1.00	0.92 (0.67,1.25)	0.74 (0.56,0.99)*	1.00	0.62 (0.34,1.12)	0.75 (0.40,1.40)	1.00	1.13 (0.78,1.66)	0.75 (0.55,1.03)
Fairly/very bad	1.00	1.13 (0.79,1.61)	0.48 (0.33,0.70)**	1.00	0.67 (0.32,1.39)	0.83 (0.38,1.80)	1.00	1.43 (0.94,2.18)	0.42 (0.27,0.64)**
Sleep latency ^f									
< 30 min	REF			REF			REF		
≥ 30 min	1.00	1.23 (0.95,1.59)	0.67 (0.52,0.88)**	1.00	1.24 (0.70,2.20)	0.75 (0.39,1.46)	1.00	1.26 (0.94,1.68)	0.67 (0.50,0.90)**

** $P < 0.01$.

* $P < 0.05$.

^a Model adjusted for sex, study grade, major, resident location, parent relationship, smoke, alcohol, physical exercise, classmate party and courtship.

^b Model adjusted for study grade, resident location, parent relationship, smoke, physical exercise and classmate party.

^c Model adjusted for BMI, study grade, major, resident location, parent relationship, alcohol, physical exercise, classmate party and courtship.

^d Multivariate linear regression was used. Values are β coefficients (standard errors).

^e Multinomial logistic regression was used. Values are odds ratios (95%confidence intervals).

^f Binary logistic regression was used. Values are odds ratios (95%confidence intervals).

theory, so we inferred common mechanism might exist in the associations of social support and social stress to sleep status. We only found weak associations of social integration with PSQI scores, maybe, due that number of friends was only one component and it could not reflect the whole status of social integration, or integration itself can not influence sleep status obviously. These results imply that perfecting relative support system in schools and alleviating bad effects of social stress can bring benefits to sleep status in undergraduates.

Gender differences existed in sleep status in present study. Women had worse subjective sleep quality, shorter sleep duration

and longer sleep latency than men, and the results were consistent with previous studies in Chinese students (Tsai and Li, 2004; Suen et al., 2008; Cheng et al., 2012). It has been confirmed that women have predisposition of poor sleep, which might be explained by either sex differences in susceptibility of depression and anxiety or genuine sex-specific changes in sleep physiology (Zhang and Wing, 2006). So when considering sleep problems in undergraduates, more attention should be paid to female students. In our data, social support and social stress could both play important roles in sleep status in men and especially in women. Women had heavier stress, less friends and tended to had better support than

Table 5
Relationships between number of friends and sleep.

	Friends living locally					
	Total (n=1632) ^a		Men (n=343) ^b		Women (n=1289) ^c	
	0–10	≥ 11	0–10	≥ 11	0–10	≥ 11
Sleep conditions^d						
PSQI	REF	−0.23(0.09) [*]	REF	−0.14(0.23)	REF	−0.22(0.10) [*]
Sleep duration^d						
Actual sleep time	REF	0.06(0.05)	REF	−0.08(0.11)	REF	0.10(0.06)
Sleep efficiency^d						
Sleep/bed time	REF	0.01(0.01)	REF	−0.02(0.02)	REF	0.02(0.01) [*]
Subjective sleep quality^e						
Very good	REF		REF		REF	
Fairly good	1.00	1.08(0.84,1.38)	1.00	1.38(0.82,2.30)	1.00	1.02(0.77,1.36)
Fairly/very bad	1.00	0.91(0.67,1.22)	1.00	1.30(0.69,2.45)	1.00	0.85(0.61,1.20)
Sleep latency^f						
< 30 min	REF		REF		REF	
≥ 30 min	1.00	0.98(0.79,1.21)	1.00	1.03(0.62,1.73)	1.00	0.97(0.76,1.23)
	Friends living at a distance					
	0–7	≥ 8	0–7	≥ 8	0–7	≥ 8
Sleep conditions^d						
PSQI	REF	−0.12(0.09)	REF	−0.33(0.23)	REF	−0.09(0.10)
Sleep duration^d						
Actual sleep time	REF	0.01(0.05)	REF	0.01(0.12)	REF	0.01(0.06)
Sleep efficiency^d						
Sleep/bed time	REF	0.01(0.01)	REF	0.00(0.02)	REF	0.01(0.01)
Subjective sleep quality^e						
Very good	REF		REF		REF	
Fairly good	1.00	1.04(0.81,1.33)	1.00	0.75(0.44,1.27)	1.00	1.15(0.87,1.52)
Fairly/very bad	1.00	0.86(0.64,1.15)	1.00	0.72(0.38,1.37)	1.00	0.90(0.64,1.26)
Sleep latency^f						
< 30 min	REF		REF		REF	
≥ 30 min	1.00	0.99(0.80,1.22)	1.00	0.90(0.53,1.50)	1.00	1.01(0.80,1.28)

^{**} $p < 0.01$.

^{*} $p < 0.05$.

^a Model adjusted for sex, study grade, major, resident location, parent relationship, smoke, alcohol, physical exercise, classmate party and courtship.

^b Model adjusted for study grade, resident location, parent relationship, smoke, physical exercise and classmate party.

^c Model adjusted for BMI, study grade, major, resident location, parent relationship, alcohol, physical exercise, classmate party and courtship.

^d Multivariate linear regression was used. Values are β coefficients (standard errors).

^e Multinomial logistic regression was used. Values are odds ratios (95%confidence intervals).

^f Binary logistic regression was used. Values are odds ratios (95%confidence intervals).

men (Table 1). It has been demonstrated that social support can buffer or reduce the effect of stress for women more than for men (Elliott, 2001). Besides, women also suffered more stress and were more vulnerable in negative social interactions (Rosenfield and Mouzon, 2013), and these negative social bonds increased mental health problems more than social support reduced them (Newsom et al., 2003). So we can imply that women are more sensitive to social relationships and get more influence to their health. The weaker associations in men can also be partly interpreted by the smaller sample size.

Social relationship structure was influenced deeply by society and culture. Chinese people put more emphasize on interpersonal relationship than most western countries (Chang and Holt, 1991). They prefer stable and persistent social relationships and need acceptance in these relationships (Yang, 2010). Besides, one-child policy in China makes Chinese children more sensitive and vulnerable (Yang, 2009). These Chinese culture backgrounds may play roles in the association between social relationships and sleep. For further understanding these, more specific studies are needed. We are sure that culture specific characters should be taken into consideration when taking interventions.

In present study, only five parts of PSQI, subjective sleep quality, sleep duration, habitual sleep efficiency, use of sleeping medication, and daytime dysfunction, were scored so the total score was 15, and sleep latency was assessed by one question; thus leading to the incompleteness of the PSQI scale. Tsai et al. (2005) has evaluated Chinese version of PSQI in Chinese people and

documented subjective sleep quality ($r=0.75$), sleep duration ($r=0.58$), habitual sleep efficiency ($r=0.61$), use of sleeping medication ($r=0.60$), and daytime dysfunction ($r=0.60$) were well correlated with the PSQI score. Liu et al. (1996) study also corroborated similar results in undergraduate students, with Pearson correlation coefficient equal to 0.76, 0.36, 0.43, 0.25 and 0.57, respectively. So the score of five components was still thought to be efficient to a certain extent. Since Tsai and Liu's studies (Liu et al., 1996; Tsai et al., 2005) all reported subjective sleep quality to be the most correlated component with the global PSQI score, and our data also showed good correlation ($r=0.67$), so we analyzed the association between social relationships and subjective sleep quality individually to confirm our results. Besides, we also assessed sleep latency by one question to cover the absence of 'sleep latency' component in PSQI score.

In addition, the results of our study should be interpreted cautiously because of following limitations. First, like all cross-sectional study, the causality of the association between social relationships and sleep status cannot be established. There is possibility that better sleep makes social relationships well and sleep problems can disturb social activity. Actually, there is evidence that disrupted sleep can have some effects on neuroendocrine stress systems and stress responsivity, which in turn affect social activities (Meerlo et al., 2008). Second, all data were self-reported in this study so recall bias existed inevitably. Third, our subjects were undergraduate students in east China, and the majority were medical students; thus our results might not be

extrapolated to other regions or other populations. Fourth, because of deficient data, the rate of subjects enrolled in the analysis (71.1%) was not high. We compared enrolled subjects ($N=1632$) and excluded subjects ($N=645$) and found no significant differences exist, indicating the stability of our sample (data not shown). Fifth, the majority students were females, leading the unequal of gender composition. Enlarging sample size of men would increase the generalizability of the findings. Sixth, negative mood may influence social relationships as well as perceived sleep quality, so it should be cautious when interpret the association between social relationships and sleep. Seventh, repeated multivariate analysis might increase type I error. In the future, prospective studies with rigorous design and large sample size are needed to confirm the results, as well as underlining mechanisms.

In summary, social stress and support were associated with sleep status in Chinese undergraduate students. Research works are needed to seek the physiological and psychological mechanisms of the links between social relations and sleep, and experimental researchers can be designed to improve students' quality of their social relationships to determine whether such changes can result in benefits to sleep. We should always keep in mind that what we concern is not only sleep. As mentioned above, sleep was considered as a mechanism by which social relationships affect health (Hale, 2010), so the roles of poor sleep status in the development of students' future health is also a significant question. Suggestions are as follows. First, educators and instructors should be aware of the importance of healthy sleep and psychological health in undergraduates. Second, more attention should be paid on undergraduates' social relationships, like friendships, classmate relationships, or if necessary, family relationships. Systematic educational programs like courses, group guidance and peer educations can be used to establish and maintain good social bonds for undergraduates. Third, psychological counseling service should be provided unimpededly, and sleep experts are needed to help students cope with practical problems.

Contributors

YXY conceived the idea of this study and made critical revisions. YLJ design the study and drafted the manuscript. ZYD performed in data analysis and drafted the manuscript. YF, WJ, SSZ, LJW and ZPW conducted the survey and performed data collection. HL and ZXC participated in data analysis and critical revisions. SCZ made significant contribution to the initial plan and critical revisions of the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at <http://dx.doi.org/10.1016/j.psychres.2014.08.029>.

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